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1986 Turfgrass Management Annual Research Summary Report

University of Tennessee Agricultural Experiment Station

Lloyd M. Callahan

The University of Tennessee
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Department of Ornamental Horticulture
and Landscape Design

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TURFGRASS MANAGEMENT ANNUAL

RESEARCH SUMMARY REPORT

Department of Ornamental Horticulture and Landscape Design

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Perennial Ryegrass Cultivar Evaluations

for Lawn Adaptation in Tennessee

L. M. Callahan, L. D. Lester and S. A. Ball

Objectives of this study are to evaluate selected cultivars of perennial ryegrass (*Lolium perenne* L.) for adaptation under lawn conditions at Knoxville, Tennessee. Evaluations are part of a southern regional cooperative adaptation program following uniform management practices and data criteria.

Methods and Materials

Perennial ryegrass cultivars were seeded September 19, 1983, at 5 pounds per 1,000 sq. ft. The test area consisted of 4 ft. by 6 ft. plots with three replications. Plots were mowed weekly at a cutting height of 2 1/2 inches with clippings dropped. Fertilizer was applied four times per year totaling 4-1-2 pounds actual N-P_2O_5-K_2O per 1,000 sq. ft. Plots were irrigated as needed and no pesticides were applied.

Results and Discussion

Perennial ryegrass cultivars in this study have only been under evaluation for three years. Cultivar evaluation studies generally should be conducted for a minimum of five years before reliable recommendations can be made. The following discussion applies only to the progress of this study. It should be remembered also that perennial ryegrasses generally are short-lived perennials, as compared to Kentucky bluegrass which is a long-lived perennial.

Green stand density. Stand density reflects grass response to practically all types of environmental stress and disease and thus is the most important performance criterion. Perennial ryegrasses develop stand density through an upright, bunch-type growth. They maintain density through prolific tillering and short rhizome growth.

Leading perennial ryegrass cultivars exhibiting 90% and higher green stand densities from September 1983 to September 1984 were Fiesta, Gator, Pennant, Premier, and Palmer (Table 1). During the second year test period (1984 to 1985), Gator, Pennant, and Premier repeated as leaders but were joined by Regal, Diplomat, and the Rutgers Experimental M-382 (Table 1).

During the third year of evaluations (1985 to 1986), leading perennial ryegrass cultivars were Pennant, Premier, and Regal (repeating as leaders), Acclaim, Pennfine, and Omega (Table 1).

Quality appearance. This is a composite category combining green stand density, leaf blade color, texture (leaf blade width), and injury from parasitic diseases, insects, and high and low temperatures. Perennial ryegrass cultivars in 1983-84, exhibiting quality appearance scores of 7.3 (on a scale of 1 - 9; 9 = best) and above, were Fiesta, Prelude, Pennant, Gator, Palmer, Blazer, Yorktown II, and Premier (Table 1). Gator, Pennant, and Premier repeated among the leaders in quality appearance in 1984-85 (Table 1). Other leading cultivars were Regal, Rutgers M-382, and SWRC-1.

The highest "Quality Appearance" value exhibited in 1985 to 1986 was a 6. All cultivars with the highest green stand density ratings exhibited a quality appearance value of 6.

Table 1. Perennial ryegrass cultivar evaluations for adaptation, 1983 to 1986, at Knoxville, Tennessee.

	1983-84 Results			1984-85 Results			1985-86 Results		
		% Green	Qlty 1/		% Green	Qlty		% Green	Qlty
Rank	Cultivar	Std Den	Appear	Cultivar	Std Den	Appear	Cultivar	Std Den	Appear
1.	Fiesta	95	9.0	Regal	78	6.8	Regal	88	6
2.	Gator	95	8.0	Gator	72	6.6	Acclaim	87	6
3.	Pennant	94	8.5	Pennant	72	6.3	Pennfine	85	6
4.	Prelude	93	9.0	Premier	72	6.7	Premier	83	6
5.	Premier	92	7.3	Diplomat	71	6.1	Omega	83	6
6.	Palmer	91	7.7	Rut.M-382	71	6.2	Pennant	82	6
7.	YorktownII	90	7.5	SWRC-1	70	6.2	Prelude	80	6
8.	SWRC-1	88	6.7	Palmer	69	6.1	Barry	80	6
9.	Rut.M-382	86	6.0	Prelude	69	6.1	Citation	80	6
10.	Acclaim	86	6.0	Derby	67	5.8	Fiesta	80	6
11.	Blazer	85	7.5	Acclaim	66	5.4	Ranger	80	5
12.	Derby	85	6.0	Blazer	66	5.5	Blazer	80	5
13.	Barry	85	6.0	Ranger	66	6.0	Palmer	78	5
14.	Pennfine	85	5.5	Barry	65	5.2	Derby	77	6
15.	Regal	83	6.5	Fiesta	64	5.4	Diplomat	75	6
16.	Omega	83	5.5	Omega	64	5.9	Gator	75	6
17.	Ranger	82	5.5	YorktownII	63	5.0	SWRC-1	73	5
18.	Diplomat	80	6.0	Pennfine	62	5.1	Rut.M-382	70	6
19.	Citation	73	4.3	Citation	61	4.8	YorktownII	65	4
20.	Common	35	1.7	Common	36	2.2	Common 2/	80	5

1/ General overall quality appearance: 1-9; 9=Best

2/ Common perennial ryegrass is reseeded each year in late August.

General Comments. Environmental stresses on the cultivars were generally less during the 1985 to 1986 evaluation period than during previous years. Sod webworm and disease activity was negligible with no agreement between replications, thus these categories were not reported for the third year. An example of negligible stress effects was exhibited by common perennial ryegrass which retained 80% stand density. Even though common perennial ryegrass plots had to be reseeded each evaluation year, this variety performed well during the third year.

Herbicide Combination Effects

In a Bentgrass Green

L. M. Callahan and D. P. Shepard

The purpose of this study is to determine the effectiveness of selected preemergence herbicides applied singularly and in combination (follow-up) treatments in controlling large crabgrass (Digitaria sanguinalis) and goosegrass (Eleusine indica) in a bentgrass (Agrostis palustris Huds. 'Penncross') green. In addition, herbicide phytotoxicity to the bentgrass and effectiveness of soil/herbicide residues in weed control is being evaluated. This study has completed the third year of a four year investigation period.

Methods and Materials

Large crabgrass and goosegrass are cross-seeded in separate strips into the plots during early February of each year. Goosegrass was not seeded in 1986 due to the unavailability of commercial seed. All herbicide treatments were made in 1984 and 1985. No herbicide treatments were made in 1986 in order to determine the effectiveness of chemical soil residues applied in 1984 and 1985 in controlling crabgrass and herbicide residual phytotoxicity to the bentgrass.

Individual herbicide application dates were March 1, April 1, and April 15. Combination herbicide application dates were March 1, for the first chemical treatments, followed by April 1 or an April 15 application for the second treatment. Chemical formulations and rates applied are shown in Table 2.

The study is being conducted in a high porosity sand-organic matter green. Physical analysis of the green soil rootzone is similar to that for a U.S. golf association specification green.

Table 1. Individual herbicide common names, trade names, formulations and rates applied.

Common Name	Trade Name	Formulation	lb ai/acre
Benefin	Balan	2.5 G	2 and 4
Bensulide	Betasan	7 G	5 and 10
Oxadiazon	Ronstar	2 G	2 and 4
Oxadiazon	Ronstar	50 W	2 and 4
Oxadiazon Benefin/UF*	Regalstar	1/0.5 G	2/1 and 4/2

(Regalstar = oxadiazon 1%/benefin 0.5%/Ureaform* 38%)

Table 2. Combination herbicides, formulations, and rates applied.

March 1 Treatments			April 1 or April 15 Treatments	
Herbicide/Form.	lb ai/ acre		Herbicide/Form.	lb ai/ acre
Benefin G	2	+	Oxadiazon G	2
Benefin G	4	+	Oxadiazon G	4
Benefin G	2	+	Regalstar G	2/1
Benefin G	4	+	Regalstar G	4/2
Bensulide G	5	+	Oxadiazon G	2
Bensulide G	10	+	Oxadiazon G	4
Oxadiazon G	2	+	Bensulide G	5
Oxadiazon G	4	+	Bensulide G	10
Benefin G	2	+	Bensulide G	5
Benefin G	4	+	Bensulide G	10

Results and Discussion

1985 Weed Control and Bentgrass Response

Crabgrass control. Individual herbicide treatments giving 90 to 100% control of crabgrass with applications on March 1 and April 1 were Oxadiazon at 4 lb ai/A and Regalstar 4/2 lb ai/A (Table 3). Crabgrass control was 94 to 100% on April 15 with both the 2 and 4 lb ai/A rates of Oxadiazon and the 2/1 and 4/2 lb ai/A rates of Regalstar.

Table 3. Percent crabgrass control in a Penncross bentgrass green following individual preemergence herbicide treatments during Spring, 1985. 1/

Herbicide/Form.	**lb. ai/ acre**	**Treatment Dates**		
		March 1	**April 1**	**April 15**
Benefin 2.5 G	2	24%	41%	66%
	4	44	62	84
Bensulide 7 G	5	6	23	44
	10	28	41	78
Oxadiazon 2 G	2	76	82	94
	4	100	100	100
Oxadiazon 50 W	2	62	79	97
	4	90	94	100
Regalstar G	2/1	75	84	94
	4/2	100	100	100

1/ Crabgrass germinated April 19, 1985.

Crabgrass was 90 to 100% controlled with all herbicide combination treatments applied on March 1 + April 1 and March 1 + April 15, except the combination of Benefin at 2 lb + Bensulide at 5 lb ai/A (Table 4).

Table 4. Percent crabgrass control in a Penncross bentgrass green following combination preemergence herbicide treatments during Spring, 1985. 1/

Herbicide/Form.	lb ai/acre		Treatment Dates March 1 +April 1	March 1 +April 15
Benefin G	2 + Oxadiazon G	2	100%	100%
	4 +	4	100	100
Benefin G	2 + Regalstar G	2/1	100	100
	4 +	4/2	100	100
Bensulide G	5 + Oxadiazon G	2	100	100
	10 +	4	100	100
Oxadiazon G	2 + Bensulide G	5	100	100
	4 +	10	100	100
Benefin G	2 + Bensulide G	5	79	86
	4 +	10	90	98

1/ Crabgrass germinated April 19, 1985.

Goosegrass control. Individual herbicide treatments giving 100% control of goosegrass were both rates of Oxadiazon 2 G on all three treatment dates, Oxadiazon 50 W at 4 lb ai/A on April 15, and Regalstar at 4/2 lb ai/A on all three dates (Table 5). Oxadiazon 50 W at 4 lb ai/A on April 1 and Regalstar 2/1 lb ai/A on April 15 gave 91% control of goosegrass.

Table 5. Percent goosegrass control in a Penncross bentgrass green following individual preemergence herbicide treatments during Spring, 1985. 1/

Herbicide/Form.	lb ai/ acre	Treatment Dates March 1	April 1	April 15
Benefin 2.5 G	2	0%	0%	0%
	4	13	22	26
Bensulide 7 G	5	4	0	0
	10	17	13	22
Oxadiazon 2 G	2	100	100	100
	4	100	100	100
Oxadiazon 50 W	2	74	70	78
	4	87	91	100
Regalstar G	2/1	83	87	91
	4/2	100	100	100

1/ Goosegrass germinated May 20, 1985.

Goosegrass control was 100% following both treatment sequence dates with all herbicide combinations containing Oxadiazon (Table 4).

Table 6. Percent goosegrass control in a Penncross bentgrass green following combination preemergence herbicide treatments during Spring, 1985. 1/

			Treatment Dates	
Herbicide/Form.	**lb ai/acre**		**March 1 +April 1**	**March 1 +April 15**
Benefin G	2 + Oxadiazon G	2	100%	100%
	4 +	4	100	100
Benefin G	2 + Regalstar G	2/1	100	100
	4 +	4/2	100	100
Bensulide G	5 + Oxadiazon G	2	100	100
	10 +	4	100	100
Oxadiazon G	2 + Bensulide G	5	100	100
	4 +	10	100	100
Benefin G	2 + Bensulide G	5	37	49
	4 +	10	68	82

1/ Goosegrass germinated May 20, 1985.

Stand density. Stand density of the Penncross bentgrass is a measure of sod loss (phytotoxicity) following herbicide treatments. Bentgrass stand density was 99 to 100% following all individual herbicide applications on all three treatment dates (Table 7). However, foliage discoloration or chlorosis did persist for approximately 4 to 6 weeks following treatments with Oxadiazon 2 G and 50 W, and Regalstar at both rates for the dates shown in Table 7.

Table 7. Stand density of a Penncross bentgrass green following individual preemergence herbicide treatments during Spring, 1985.

Herbicide/Form.	lb ai/ acre	Treatment Dates March 1	April 1	April 15
Check		100%	100%	100%
Benefin 2.5 G	2	100	100	100
	4	100	100	100
Bensulide 7 G	5	100	100	100
	10	100	100	100
Oxadiazon 2 G	2	100	*100	100
	4	100	*100	*99
Oxadiazon 50 W	2	100	*100	100
	4	100	*100	*99
Regalstar G	2/1	100	*100	100
	4/2	*100	*100	*100

* = Foliage discoloration.

Stand density of the bentgrass was 98 to 100% following all combination herbicide applications for both treatment sequence dates (Table 8). Again, bentgrass foliage discoloration was evident with herbicide treatments containing Oxadiazon.

Table 8. Stand density of a Penncross bentgrass green following combination preemergence herbicide treatments during Spring, 1985.

Herbicide/Form.	lb ai/acre			Treatment Dates March 1 +April 1	March 1 +April 15
Check				100%	100%
Benefin G	2 +	Oxadiazon G	2	*100	*100
	4 +		4	*100	*100
Benefin G	2 +	Regalstar G	2/1	*100	*100
	4 +		4/2	* 99	* 98
Bensulide G	5 +	Oxadiazon G	2	*100	*100
	10 +		4	* 99	*100
Oxadiazon G	2 +	Bensulide G	5	100	100
	4 +		10	*100	*100
Benefin G	2 +	Bensulide G	5	100	100
	4 +		10	100	100

* = Foliage discoloration

1986 Herbicide Residue Effects

Crabgrass residue control. No herbicide soil residues, following both individual and combination chemical treatments in 1985, resulted in control of crabgrass during 1986 in the high porosity rootzone bentgrass green.

Bentgrass residual phytotoxicity: No herbicide buildup from 1984 and 1985 treatments resulted in residual foliage observed phytotoxicity of the bentgrass during 1986. A weakening of the bentgrass root system did result during 1986 following all individual and combination treatments involving Oxadiazon made during 1984 and 1985.

Annual Weedy Grass Control

With Treatment Programs of Arsenic

L. M. Callahan and D. P. Shepard

This is an ongoing study to determine the effectiveness of Arsenic in controlling annual bluegrass (Poa annua var. annua), large crabgrass (Digitaria sanguinalis), and goosegrass (Eleusine indica) in a bentgrass (Agrostis palustris Huds. 'Penncross') green. Determinations are being made of Arsenic residues and its persistence at various soil depths in the green rootzone. Determinations also include phytotoxic effects of the Arsenic to the bentgrass following the variable rates and treatment dates of the different programs.

Methods and Materials

The objectives of the variable Arsenic program treatments is to gradually remove the more difficult to control annual bluegrass with minimal injury to the bentgrass. The study is being conducted with Tricalcium Arsenate 26% flowable (Turf-Cal) in a bentgrass PURR-WICK Green. Arsenic treatments, as expressed in Table 1, are in Pints of Product/1,000 sq. ft.

Plot size is 4 ft. by 14 ft. with the entire plot receiving an Arsenic treatment, except for check plots. Annual bluegrass was seeded into a 4 ft. wide strip across all plots February 6 and September 5, 1986. Large crabgrass was seeded into a 2 ft. wide strip across all plots February 6, 1986.

Since a commercial source of goosegrass seed was not available during 1986, this weed was temporarily omitted. The weed seeded cross-strips received no fertilizer. The non-weed seeded portion of the bentgrass plots were regularly fertilized. Weed control is shown in Tables 1 and 2 and phytotoxicity to bentgrass in Table 3. The high percentage of bentgrass in Table 3 reflects the portion of the plot not seeded to weeds.

Results and Discussion

Crabgrass control. Residue carryover of Fall 1985 treatments totaling 6 pints of Turf-Cal was sufficient to give 70 to 98% control of crabgrass (Table 1, Program 2). Turf-Cal treatments continuing from 1985 into 1986 generally gave good control of crabgrass. The highest control of crabgrass in 1986 (98 to 100%) was achieved with programs continuing Turf-Cal treatments from Fall 1985 into Spring 1986 (Table 1, Programs 7 and 8).

Residue carryover of programs supplying low rates, ex. totaling 4 pints of Turf-Cal, or programs requiring Arsenic soil residues to persist for long periods, generally gave poor control of crabgrass when evaluated in 1986.

Annual bluegrass control. Annual bluegrass proved to be a very difficult weed grass to control, although soil Arsenic buildup from 1985 plus 1986 treatments did improve control over 1985 results (Table 2). The most successful programs were those with treatments made during Fall 1985 and continuing through Spring 1986, or through Spring and Fall 1986. Highest control was 93% with Program 8 totaling 10 pints of Turf-Cal, followed by 88% with Program 7 totaling 8 pints of Turf-Cal, then 86% with Program 15 totaling 8 pints of Turf-Cal.

Bentgrass phytotoxicity. The bentgrass was in a mature sod state throughout 1986 and generally exhibited excellent tolerance to the 1 or 2 pints /1,000 sq. ft. rate increments of Turf-Cal (Table 3). Untreated (check) plots of bentgrass showed stand densities from 95 to 99%. Treatment Programs 6, 7 and 15 totaled 8 pints and Program 8 totaled 10 pints/1,000 sq. ft. of Turf-Cal with a bentgrass stand density range from 94 to 99%. Thus far, residual plus current treatment totals of Turf-Cal Arsenic has not significantly reduced the mature stand of Penncross bentgrass.

Table 1. Percent control of large crabgrass with treatment programs of Arsenic in a Purr-Wick bentgrass green during 1986. 1/

Prog. No.	Treatment Rates and Dates 2/ (Pints/1,000 sq. ft.)	Percent crabgrass control 3/						
		6-12	6-19	6-26	7-10	7-25	8-7	8-22
1.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85	45%	49%	2%	22%	29%	30%	27%
2.	2 pt 9-15/2 pt 10-15/2 pt 11-15-85	97	98	86	79	80	70	70
3.	2 pt 3-15/1 pt 4-15/ 1 pt 5-15-85	67	64	57	53	48	43	43
4.	2 pt 3-15/2 pt 4-15/ 2 pt 5-15-85	94	96	84	51	52	50	47
6.	2 pt 3-15/1 pt 4-15/ 1 pt 5-15/+ 2 pt 9-15/1 pt 10-15/1 pt 11-15-85	70	67	69	58	60	60	60
7.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 2 pt 3-15/1 pt 4-15/1 pt 5-15-86	100	100	100	100	100	98	98
8.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85 +2 pt 3-15/2 pt 4-15/2 pt 5-15-86	100	100	100	99	100	98	100
13.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 1 pt 3-15/1 pt 9-15-86	45	38	31	22	33	43	33
14.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 1 pt 3-15/1 pt 4-15/1 pt 9-15-86	79	84	75	69	72	67	67
15.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 1 pt 3-15/1 pt 4-15/1 pt 9-15/ + 1 pt 10-15/1 pt 11-15-86	100	100	88	85	86	81	81

1/ Large crabgrass was seeded into the plots February 6, 1986.

2/ Treatments began in 1985 with the first date shown for each program.

3/ Results are shown for June 12, 19 and 26, July 10 and 25, and August 7 and 22, 1986.

Table 2. Percent control of annual bluegrass with treatment programs of Arsenic in a Purr-Wick bentgrass green during 1986. 1/

Prog No.	Treatment Rates and Dates 2/ (Pints/1,000 sq. ft.)	Percent annual bluegrass control 3/ 3-24	4-23	5-27	6-26	9-23	10-17	11-25
1.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85	39%	49%	59%	53%	22%	18%	15%
2.	2 pt 9-15/2 pt 10-15/2 pt 11-15-85	43	42	72	74	0	15	0
3.	2 pt 3-15/1 pt 4-15/1 pt 5-15-85	7	0	15	11	8	15	0
4.	2 pt 3-15/2 pt 4-15/2 pt 5-15-85	21	13	31	22	8	15	3
6.	2 pt 3-15/1 pt 4-15/1 pt 5-15/ + 2 pt 9-15/1 pt 10-15/1 pt 11-15-85	72	71	67	63	8	21	3
7.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 2 pt 3-15/1 pt 4-15/1 pt 5-15-86	62	80	88	86	35	46	25
8.	2 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 2 pt 3-15/2 pt 4-15/2 pt 5-15-86	62	82	93	91	46	58	59
13.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 1 pt 3-15/1 pt 9-15-86	13	57	63	74	63	63	59
14.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 1 pt 3-15/1 pt 4-15/1 pt 9-15-86	21	67	80	79	63	55	53
15.	1 pt 9-15/1 pt 10-15/1 pt 11-15-85 + 1 pt 3-15/1 pt 4-15/1 pt 9-15/ + 1 pt 10-15/ 1 pt 11-15-86	31	64	84	86	63	72	81

1/ Annual bluegrass was seeded into the plots February 6 and September 5, 1986.

2/ Treatments began in 1985 with the first date shown for each program.

3/ Results are shown for March 24, April 23, May 27, June 26, September 23, October 17 and November 25, 1986.

Table 3. Stand density of Penncross bentgrass following treatment programs of Arsenic in a Purr-Wick green during 1986. 1/

	Dates of stand density determinations (%) 3/											
Prog No. 2/	3-24	4-8	4-23	5-13	5-27	6-12	6-26	7-10	8-1	8-12	10-17	11-25
1.	89	90	89	91	92	93	94	96	98	97	99	95
2.	96	95	96	97	97	98	98	98	98	97	96	98
3.	96	93	94	95	96	96	97	98	98	97	97	99
4.	98	97	97	98	98	98	98	98	98	97	99	99
5. Untreated	96	96	95	95	96	96	97	98	98	97	97	98
6.	99	98	97	98	98	97	98	98	98	97	96	99
7.	96	94	94	96	96	97	97	98	99	97	97	99
8.	97	96	96	97	97	97	97	98	98	97	98	96
9. Untreated	97	97	97	96	97	97	98	98	98	97	97	98
10. Untreated	99	98	98	98	98	98	98	98	98	98	97	99
11. Untreated	98	97	97	97	97	97	98	99	99	98	97	98
12. Untreated	98	98	98	97	97	97	97	98	98	98	97	97
13.	96	95	95	94	96	96	97	98	98	97	95	98
14.	97	97	96	96	96	96	97	98	98	97	97	98
15.	95	95	95	95	95	96	97	97	97	96	95	97
16. Untreated	98	98	98	97	97	97	98	98	98	97	97	99

1/ Purr-Wick green seeded to Penncross bentgrass September 7, 1984.

2/ See Table 1 or 2 for treatment rates and dates corresponding with treatment program numbers.

3/ Stand density percentages of bentgrass are for the non-weed seeded portion of the plot.

Herbicide Phytotoxicity and Crabgrass Control in a Lawn of Tifway and Midiron Bermudagrass

L. M. Callahan and D. P. Shepard

Studies are being conducted to determine the tolerance of Tifway and Midiron bermudagrass (Cynodon dactylon (L) Pers.) grown under lawn conditions to selected herbicides and herbicide mixtures with and without combinations of Ureaform nitrogen. Investigations also include effectiveness of the various treatment combinations in controlling large crabgrass (Digitaria sanguinalis).

Methods and Materials

Mature lawn plots of Tifway and Midiron bermudagrass are maintained with weekly mowings at 2-inches, with clippings caught and removed, with irrigation, and annual fertilization supplying 4 pounds N and 1 pound each of P_2O_5 and K_2O/ 1,000 square feet.

Individual or combination herbicides (Table 1) were applied at a 1 x and 2 x rate in plots 3 ft. by 10 ft. in size with 1 ft. borders between plots. All treatments were replicated three times. Herbicide applications were made May 1, 1986. Just prior to herbicide treatments, and on the same day, a 2 ft. cross strip in each replication was vertically mowed, vacuumed, and scalped to the ground with a mower. Large crabgrass was then seeded into the cross strips with a drop-type seeder. Immediately following herbicide treatments both chemicals and the crabgrass seed was irrigated. The non-crabgrass seeded portion of each plot received regular fertilization but the crabgrass seeded portion received no fertilizer.

Results and Discussion

Crabgrass control. Control of crabgrass in Midiron bermudagrass 10 weeks following herbicide treatments (July 11) was 100% with both rates of RS-D-3 and RS-D-9, and with the 2 x rate of all the remaining RS-D experimentals, Pendimethalin, and Regalstar (Table 2). By September 9, 19 weeks following herbicide teatments, 91 to 100% control of crabgrass was exhibited by both rates of RS-D-3, RS-D-4, RS-D-8, RS-D-9, and Regalstar. The high rates of RS-D-1, RS-D-2, RS-D-3A, RS-D-6, and Pendimenthalin gave 93 to 99% control of crabgrass. Chlorsulfuron and Sulfometuron Methyl failed to control crabgrass at the rates used.

Crabgrass control in Tifway bermudagrass at 10 weeks (July 11) was 90 to 100% with both rates of RS-D-3, RS-D-3A, RS-D-4, RS-D-8, Pendimethalin, Regalstar, and the high rate of RS-D-1 (Table 3). Again, Chlorsulfuron and Sulfometuron Methyl failed to control crabgrass at the rates used.

Bermudagrass stand density. The check or untreated plots of Midiron bermudagrass exhibited a density of 87% at 10 weeks following herbicide treatments (Table 2). Bermudagrass density in all herbicide treated plots closely equaled that of untreated plots, or exceeded it, except for the high rate of Pendimethalin which resulted in 77% density. By 19 weeks Midiron bermudagrass density in untreated plots dropped to 50%, reflecting a heavy density of crabgrass and some bare ground. Bermudagrass in all herbicide treated plots ranged from 85 to 99% stand density.

Tifway bermudagrass stand density in untreated plots was 93% on July 11 (Table 3). Tifway bermudagrass density in all herbicide treated plots ranged from 91 to 97%. By September 9 untreated plots exhibited 90% bermudagrass, and herbicide treated plots ranged from 92 to 98%, except for RS-D-9 which was 87% density following both chemical rates. The high growth rate vigor of Tifway helped reduce crabgrass to only 10% stand density in untreated plots by September 9.

Bermudagrass leaf color. All RS-D experimentals and Regalstar contained slow release nitrogen as Ureaform (UF) which provided 1.8 lb N/1,000 sq. ft. with a 1 x herbicide rate (Table 1). In general, the short term of this study did not appear to allow sufficient time for most of the water insoluble fraction of the UF to breakdown and aid grass density.

Midiron bermudagrass leaf color was medium green on September 9 in untreated plots and in plots treated with both rates of RS-D-3, RS-D-9, Chlorsulfuron, and Sulfometuron Methyl (Table 2). Leaf color was medium green with 1 x rates and dark green with 2 x rates of RS-D-1, RS-D-4, RS-D-6, and RS-D-8. Leaf color was dark green with both rates of RS-D-2, RS-D-3A, and Regalstar. Pendimethalin treated Midiron bermudagrass exhibited dark green at the high rate as the grass recovered from foliage discoloration by September 9.

Tifway bermudagrass exhibited light green foliage color on September 9 (19 weeks) in untreated plots (Table 3). Both rates of all chemicals resulted in medium green foliage on September 9, except for the low rate of RS-D-8 which was light green.

Table 1. Trade names or experimental codes, formulations, common chemical names and percent active ingredients, and the 1 x rate of each herbicide applied.

Trade Name or Experimental Code	Form.	Common name and percent ai		1 x Rate (lb ai/A)
Regalstar	G	benefin	0.5	1
		oxadiazon	1.0	2
		ureaform	38.0	76
RS-D-1	G	DCPA	5.0	10
		oxadiazon	0.5	1
		ureaform	38.0	76
RS-D-2	G	metolachlor	1.0	2
		DCPA	3.0	6
		ureaform	38.0	76
RS-D-3	G	pendimethalin	0.5	1
		oxadiazon	1.0	2
		ureaform	38.0	76
RS-D-3A	G	pendimethalin	1.0	2
		oxadiazon	0.5	1
		ureaform	38.0	76
RS-D-4	G	metolachlor	0.5	1
		oxadiazon	1.0	2
		ureaform	38.0	76
RS-D-6	G	metolachlor	1.0	2
		oxadiazon	0.5	1
		ureaform	38.0	76
RS-D-8	G	pendimethalin	1.0	2
		ureaform	38.0	76
RS-D-9	G	benefin	0.5	1
		DCPA	6.0	12
		ureaform	38.0	76
Pre-M	W	pendimethlain	60	2
Glean	DF	chlorsulfuron	75	0.14
Oust	DF	sulfometuron methyl	75	0.14

Table 2. Percent crabgrass control, stand density, and leaf coloration of a Midiron bermudagrass lawn following treatments with individual and combination herbicides during 1986. 1/

Chemical or Code 3/	Rate 4/	%Crabg.Contr. 2/ Jul 11	Sep 9	% Ber. Den. Jul 11	Sep 9	Ber. Leaf Color Jul 11	Sep 9
RS-D-3	1 x	100	98	87	92	MG	MG
	2 x	100	99	86	92	MG	MG
RS-D-9	1 x	100	95	87	92	MG	MG
	2 x	100	96	87	92	MG	MG
RS-D-4	1 x	99	95	88	92	MG	MG
	2 x	100	98	91	94	DG	DG
RS-D-8	1 x	97	99	89	92	MG	MG
	2 x	100	100	90	93	MG	DG
Regalstar	1 x	96	91	86	91	MG	DG
	2 x	100	99	89	92	DG	DG
RS-D-2	1 x	96	89	89	91	MG	DG
	2 x	100	95	89	93	DG	DG
Pendimethalin	1 x	96	73	81	89	MG	DG
	2 x	100	93	77	92	LG	MG
RS-D-6	1 x	95	76	89	85	MG	MG
	2 x	100	94	89	93	DG	DG
RS-D-1	1 x	91	87	87	92	MG	MG
	2 x	100	99	91	93	DG	DG
RS-D-3A	1 x	89	88	87	90	DG	DG
	2 x	100	93	90	92	DG	DG
Chlorsulfuron	1 x	0	0	92	95	MG	MG
	2 x	0	0	92	95	MG	MG
Sulfometuron methyl	1 x	0	0	92	95	MG	MG
	2 x	0	0	92	95	MG	MG
Check				87	50	MG	MG

1/ Herbicides were applied May 1, 1986.

2/ Large crabgrass (Digitaria sanguinalis) was seeded into plots May 1, 1986.

3/ Chemicals and Codes are given in Table 1.

4/ Rates are given in Table 1.

Table 3. Percent crabgrass control, stand density, and leaf coloration of a Tifway bermudagrass lawn following treatments with individual and combination herbicides during 1986. 1/

Chemical or Code 3/	Rate 4/	%Crabg. Contr.2/ July 11	%Crabg. Contr.2/ Sep 9	%Ber. Den. Jul 11	%Ber. Den. Sep 9	Ber. Leaf Color Jul 11	Ber. Leaf Color Sep 9
RS-D-3A	1 x	100	97	94	94	LG	MG
	2 x	100	100	94	95	MG	MG
Regalstar	1 x	100	93	94	95	MG	MG
	2 x	100	100	95	95	MG	MG
Pendimethalin	1 x	100	93	91	95	LG	MG
	2 x	100	100	93	93	LG	MG
RS-D-8	1 x	100	93	93	94	LG	LG
	2 x	100	100	94	94	MG	MG
RS-D-4	1 x	100	90	94	94	LG	MG
	2 x	100	97	95	95	MG	MG
RS-D-9	1 x	100	87	93	87	LG	MG
	2 x	100	87	94	87	MG	MG
RS-D-2	1 x	100	80	94	95	LG	MG
	2 x	100	83	94	92	MG	MG
RS-D-3	1 x	94	100	93	95	LG	MG
	2 x	100	100	95	95	MG	MG
RS-D-6	1 x	81	77	94	94	MG	MG
	2 x	100	77	96	95	MG	MG
RS-D-1	1 x	81	87	92	94	MG	MG
	2 x	94	93	95	95	MG	MG
Chlorsulfuron	1 x	0	0	97	98	LG	MG
	2 x	0	0	97	98	LG	MG
Sulfometuron methyl	1 x	0	0	97	98	LG	MG
	2 x	0	0	97	98	LG	MG
Check				93	90	LG	LG

1/ Herbicides were applied May 1, 1986.

2/ Large crabgrass (*Digitaria sanguinalis*) was seeded into plots May 1, 1986.

3/ Chemicals and Codes are given in Table 1.

4/ Rates are given in Table 1.

Principal Researcher: Dr. L. M. Callahan

Project Location: Research Park

Department of
Ornamental
Horticulture and
Landscape Design
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37901-1071

Synthetic Fabric Blanket Separations Between Grass Rootzones and Coarse Aggregate Sub-Drain Systems

L. M. Callahan, R. D. Von Bernuth, R. S. Freeland,
T. J. Samples, D. P. Shepard, and J. Hodges, III

A project is being developed of national and international scope to determine effectiveness, durability, and longevity of synthetic fabric blankets (geotextiles) as separations between turfgrass soil rootzones and coarse aggregate sub-drain systems (usually gravel), such as in U. S. Golf Association specification greens and sport turf fields. Reliability of synthetic fabrics in maintaining infiltration and percolation rates, as outlined in the analytical procedures of the USGA guidelines, will be determined. Ability of fabric materials to preserve an effective perched water table at fabric interface and ultimately conserve water use will be investigated.

Importance of Project

Commonly used separations between turfgrass soil rootzones and the sub-drain aggregate is a coarse sand layer in USGA Greens, or often no separation layer as in sport turf fields. Research shows that a reliable separation is needed to prevent particle fines in the rootzone from migrating into the gravel sub-drain and destroying the perched water table, thus resulting in variable loss of grass cover. Evolution of the problem generally takes a few years and then often is attributed to other causes, i.e. disease, poor sprinkler pattern, etc. The problem is compounded in that contractors commonly use sub-drain gravel larger than 1/2 inch diameter. The gravel used generally is sharp and linear instead of rounded pea gravel of 3/8 to 1/2 inch as specifications provide. Thus, settling or migration of the rootzone mix into the sub-drain aggregate commonly occurs. Regretfully, the pea gravel size and characteristics specifications call for is not easy to acquire.

A durable and long lasting fabric material with similar porosity to the coarse sand layer would provide an effective barrier separation for the preservation of the perched water table. A workable synthetic fabric material also would provide a better defined separation layer resulting in a more reliable perched water table. The increased efficiency of the perched water table should improve water economy and protection for the turfgrass cover. Synthetic fabric materials would also allow greater latitude by contractors in use of large size gravel in the sub-drain zone.

Methods and Materials

An aboveground Rhizotron is being developed at the Turfgrass Research facilities at The University of Tennessee, Knoxville. The Rhizotron has 44 chambers and is designed to thoroughly investigate the use of the best of the synthetic fabric blankets under a USGA soil rootzone in direct comparison to a USGA rootzone with the coarse sand layer and a USGA rootzone with no barrier separation.

Sophisticated soil moisture sensing devices and temperature sensors will be installed in all test chambers. Detailed laboratory and field infiltration and percolation rates, plus leachate volume determinations, will be determined. An in-field recording computer will be installed along with several other testing devices. Thorough and full range chemical and physical analysis will be determined in the laboratory. Various special sophisticated equipment is also being developed.

Estimated Total Cost for Project:

$50,000 Total

$10,000 Requested with this Grant Application

Estimated Completion Dates:

Significant results expected every 2 years.

Most data will be completed in 5 years.

Maximum Project period is 10 years to determine longevity of Geotextiles.

Project Period

Total investigation period is 10 years. However, several phases of data collection and analysis will be completed annually.

Project Investigators:

Dr. L. M. Callahan, Professor

Project Leader-Turfgrass Management Research

Dr. R. D. Von Bernuth, Associate Professor

Agricultural Engineering Irrigation and Drainage Specialist

Dr. R. S. Freeland, Assistant Professor

Agricultural Engineering Computer Instrumentation and Control Systems Specialist

Dr. T. J. Samples, Assistant Professor

Extension Turfgrass Management

Mr. D. P. Shepard, Research Associate

Turfgrass Management Research

Dr. J. Hodges, III, Superintendent

Knoxville Agricultural Experiment Station

Cellular Responses of Two Turfgrass Cultivars to Selected Preemergence Herbicides

S. A. Ball and L. M. Callahan

Investigations are in progress to determine anatomical and morphological responses of cells in roots of Tifgreen bermudagrass (*Cynodon dactylon* (L) Pers. x *C. transvaalensis* Burtt-Davy) and Penncross bentgrass (*Agrostis palustris* Huds.) to selected preemergence herbicides. Thus far tests have been conducted only with Tifgreen bermudagrass.

Methods and Materials

Tifgreen bermudagrass plants ten weeks of age and of uniform size were mounted in culture jars of a continuous flow and constant level solution culture renewal system in the greenhouse on June 25, 1986. Herbicide treatments were made in their respective culture jars on the first day of the study with fortification treatments made at four day intervals until seven applications had been made. Herbicide treatments are shown in Table 1.

At the end of the four week herbicide treatment period (July 23) root tips were collected for histological processing and determinations of cellular responses to each herbicide. The bermudagrass plants were then grown in herbicide free nutrient solution for an additional four weeks to determine their ability to recover from any herbicide injury. At the end of the recovery period (August 20) root tips were again collected. The plants were then removed from the culture jars, roots excised just below the crowns, and dry weights determined on separated roots and shoots for each herbicide (Table 2).

Preliminary

Results and Discussion

Shoot and root weights. All herbicide treatments resulted in greatly reduced shoot dry weights (Table 2). Reduction in shoot weights was very severe following root exposures to the herbicides Oryzalin and Sulfometuron Methyl.

No difference in root weights resulted following treatments with Fenarimol as compared to checks (Table 2). Slight reductions in root weights resulted with Chlorsulfuron and Pendimethalin, and moderate reduction resulted with Sulfometuron Methyl. However, severe reduction in root weights resulted with treatments of Oryzalin and Tricalcium Arsenate.

Table 1. Individual herbicide common names, trade names, formulations and rates used.

Common Name	**Trade Name**	**Formulation**	**lb ai/Acre**
Chlorsulfuron	Glean	75 DF	0.06
Fenarimol	Rubigan	50 W	2
Oryzalin	Surflan	75 W	2
Pendimethalin	Pre-M	60 DG	2
Sulfometuron Methyl	Oust	75 DF	0.06
Tricalcium Arsenate	Turf-Cal	2.8 EC	30

Table 2. Shoot and root dry weights of Tifgreen bermudagrass plants as influenced by herbicide exposures to the root system. 1/

Chemical	**Shoot Weights**	**Root Weights**
Chlorsulfuron	182 mg	47 mg
Fenarimol	141	56
Oryzalin	20	12
Pendimethalin	167	45
Sulfometuron Methyl	37	25
Tricalcium Arsenate	145	18
Check	301	55

1/ Dry weights reflect 4 weeks of herbicide exposure and 4 weeks of recovery with no herbicide exposure.

Cellular Responses of Two Turfgrass Cultivars to Selected Post-emergence Herbicides

J. M. Bogert and L. M. Callahan

Studies are being conducted to determine anatomical and monphological responses of cells in roots of Tifgreen bermudagrass (Cynodon dactylon (L) Pers. x C. transvaalensis Burtt-Davy) and Penncross bentgrass (Agrostis palustris Huds.) to selected post-emergence herbicides. Thus far tests have been conducted only with Tifgreen bermudagrass.

Methods and Materials

Tifgreen bermudagrass plants ten weeks of age and of uniform size were mounted in culture jars of a continuous flow and constant level solution culture renewal system in the greenhouse on September 10, 1986. Herbicide treatments were made in their respective jars on the first day of the study with fortification treatments made at four day intervals until seven applications had been made. Herbicide treatments are shown in Table 1.

At the end of the four week herbicide treatment period (October 8) root tips were collected for histological processing and determinations of cellular responses. Due to serious injury from Pronamide, root tissue was collected at three weeks to assure root tissue availability for histological processing.

The bermudagrass plants were then grown in the nutrient solution for an additional four weeks without herbicide exposure to determine their ability to recover from any herbicide injury. At the end of the recovery period (November 5) root tips were again collected. Plants were then removed from the culture jars, roots excised just below the crowns, and dry weights determined on separate roots and shoots for each respective herbicide (Table 2).

Preliminary
Results and Discussion

Shoot and root weights. All herbicide treatments resulted in some reduced shoot dry weights (Table 2). Reduction in shoot weights was very severe following root exposures to Pronamide. Moderate shoot weight reductions resulted with root exposures to Asulam and Sethoxydim, and slight to moderate reductions occurred following Bentazon and Bromoxynil treatments.

Root reduction dry weights were severe following exposure to Pronamide, and moderate with Asulam, Bromoxynil, and Sethoxydim (Table 2). Slight root weight reductions resulted following exposure to Bentazon.

Table 1. Individual herbicide common names, trade names, formulations and rates used.

Common Name	Trade Name	Formulation	lb ai/Acre
Asulam	Asulox	3.34 EC	2
Bentazon	Basogran	4 EC	1
Bromoxynil	Buctril	2 EC	0.4
Pronamide	Kerb	50 W	1
Sethoxydim	Poast	EC	0.4
+ Oil Concentrate		Oil	0.5

Table 2. Shoot and root dry weights of Tifgreen bermudagrass plants as influenced by herbicide exposures to the root system. 1/

Chemical	Shoot Weights	Root Weights
Asulam	100 mg	21 mg
Bentazon	299	68
Bromoxynil	336	37
Pronamide	47	3
Sethoxydim	129	25
Check	395	81

1/ Dry weights reflect 4 weeks of herbicide exposure and 4 weeks of recovery with no herbicide exposure.

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Diamond Shamrock
Stauffer Chemical
O. M. Scott & Sons
Regal Chemical
Lesco
Gordon
GIBA-GEIGY

Seed and Sod:

Southern Turf Nurseries
Cherry Point Sod Farms
E. F. Burlingham & Sons
Lofts Seed Inc.
International Seeds, Inc.
Peterson Seed Company
Northrup King & Co.

Other Materials:

Warren Turf Professionals, Inc.
DuPont
American Hoechst Corp.

Grants:

Regal Chemical Company
Mallinckrodt, Inc.
Rhone-Poulenc Chemical Company
DuPont
CIBA-GEIGY
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